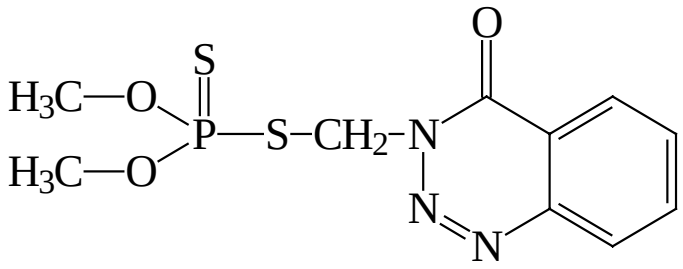
PRELIMINARY DRAFT—DO NOT CITE OR QUOTE

EVALUATION OF AZINPHOS-METHYL AS A TOXIC AIR CONTAMINANT



Executive Summary

California Department of Pesticide Regulation

California Environmental Protection Agency
Sacramento, California

July 2000

California Environmental Protection Agency
Department of Pesticide Regulation

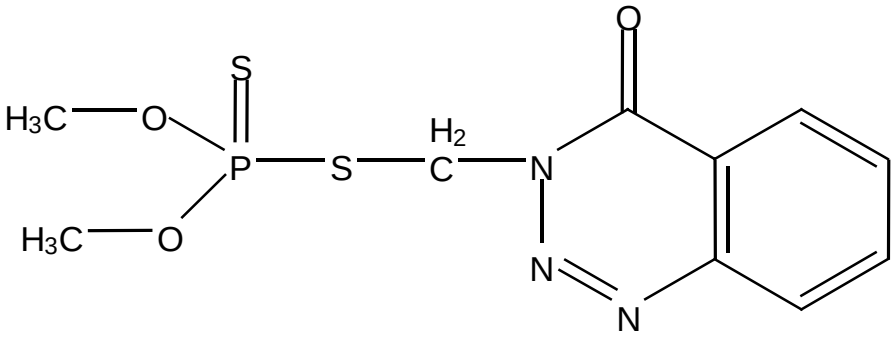
Paul E. Helliker
Director

For additional copies of this report please contact:

Department of Pesticide Regulation
Environmental Monitoring and Pest Management Branch
830 K Street
Sacramento, California 95814-3510

(916) 324-4100

EVALUATION OF AZINPHOS-METHYL AS A TOXIC AIR CONTAMINANT



Executive Summary

Prepared by the Staff of the
Department of Pesticide Regulation
California Environmental Protection Agency
Sacramento, California

California Environmental Protection Agency
Sacramento, California

July 2000
Preface

Assembly Bills 1807 and 3219 (Tanner, Chapter 1047, Statutes of 1983) established a procedure for the identification and control of toxic air contaminants (TACs) in California. Under these laws, the Department of Pesticide Regulation (DPR) has the responsibility to determine whether pesticides may be TACs. Once a pesticide has been identified as a TAC, DPR is required to determine—in consultation with the Office of Environmental Health Hazard Assessment, the Air Resources Board (ARB), the air pollution districts, and air quality management districts of the affected counties—the need for and appropriate degree of control measures (§ 14021 et seq., Food and Agricultural Code). As part of the identification process, DPR is required to prepare a report documenting the airborne concentrations of a candidate TAC, and to evaluate whether these concentrations are a present or potential hazard to human health.

In preparing this report, staff reviewed pertinent scientific literature through October 1999.

Introduction

With the enactment of California's Toxic Air Contaminant Act (Tanner, Chapter 1047, Statutes of 1983), the Legislature created the statutory framework for the evaluation and control of chemicals as toxic air contaminants. The statute defines toxic air contaminants as air pollutants that may cause or contribute to an increase in mortality or in serious illness, or that may pose a present or potential hazard to human health. The Department of Pesticide Regulation (DPR) is responsible for the evaluation of pesticides as TACs.

DPR's TAC Program focuses on the evaluation and control of pesticides in ambient community air. The program consists of two phases: risk assessment (evaluation and identification) and risk management (control). The program's first phase involves an extensive evaluation of the candidate pesticide to assess the health effects and to estimate levels of exposure associated with its use. As part of this evaluation, the law requires the preparation of a report that includes: a risk characterization and risk assessment, an exposure assessment, and an overview of the environmental fate and use of the pesticide, and air monitoring studies conducted in California to measure the levels of the candidate pesticide present in ambient air. Based on the results of this comprehensive evaluation, the Director of the Department of Pesticide Regulation (DPR) will determine whether the candidate is a TAC. Once a candidate pesticide has been determined a TAC, it enters phase two of the program, the mitigation phase.

What is contained in this report?

This report evaluates the potential for azinphos-methyl to be a TAC and includes:

- a review of the available scientific evidence on azinphos-methyl regarding its physical properties, sources of azinphos-methyl in the environment, and its environmental fate;
- results documenting ambient airborne concentrations of azinphos-methyl as well as results documenting air concentration following an application;
- an estimate of human exposure to azinphos-methyl in air;

- an assessment of the risk to humans resulting from current or anticipated exposures to airborne azinphos-methyl.

What is azinphos-methyl and how is it used?

Azinphos-methyl is a nonsystemic insecticide used to control sucking and chewing insects on a wide variety of fruits, field crops, vegetables, ornamentals, and nuts. It is available in emulsifiable concentrate, wettable powder, and wettable powder in water soluble packet or bag formulations with the Signal Word "Danger" on the product labels. As of October 1999, there were seven active registrations for products containing azinphos-methyl. Pesticide use data by county for reporting years 1990 through 1998 indicate that more than 51 percent of use occurred in Kern, Merced, Stanislaus, and Tulare Counties. Kern County accounted for nearly 30 percent of the total amount used, and was the county where highest use occurred. Although used on a wide variety of commodities, the chief uses for 1998 were on almonds (98,000 pounds), walnuts (37,000 pounds), pistachios (30,000 pounds) and apples (13,000 pounds). Annual statewide use dropped from a high of about 520,000 pounds in 1992 to about 193,000 pounds in 1998.

Azinphos-methyl is applied to soil or foliage by aerial or power-operated ground sprayers. It is also applied by chemigation through sprinkler, center pivot, lateral move, side roll, overhead solid set or low- pressure irrigation systems. Application rates for field crops range from 0.125 to 0.75 pounds of active ingredient (a.i.) per acre. Respective application rates for fruit and vegetables are 0.25 - 2.0 and 0.125 – 1.5 pounds a.i. per acre. The maximum application rate for nut crops 2.0 pounds a.i. per acre with a maximum of 3 applications per crop per season regardless of rate or formulation type.

What is the fate of azinphos-methyl in the environment?

Following application to plants, azinphos-methyl is metabolized to azinphos-methyl oxon, which degrades rapidly. Azinphos-methyl does not leach to great depths in soil, even after soil incorporation or irrigation. It is susceptible to microbial degradation in soil, and benzazimide, thiomethylbenzazimide, bis(benzazimidylmethyl)disulfide, and anthranilic acid

have been identified as principle end products. When exposed to ultra-violet light, azinphos-methyl in aqueous solution is degraded rapidly and extensively. Compounds identified after irradiation include anthranilic acid, benzazimide, N-methyl benzazimide, and methyl benzazimide sulfide. No mechanisms of photodegradation have been proposed.

What are the reported concentrations of azinphos-methyl in the air in California?

ARB measures outdoor concentrations of pesticides in the air at DPR's request. For each pesticide being evaluated, airborne concentrations are measured in the ambient community air and in the air near an application. In general, the monitoring is conducted in a county of high use, during the season of peak use.

Ambient air monitoring was conducted four days a week from June 22 through July 16, 1987 at five sites in Kern County. The monitoring was scheduled to coincide with expected applications to almond orchards. Maximum positive detections ranged from 0.028 $\mu g/m^3$ (2.2 ppt) to 0.11 $\mu g/m^3$ (8.4 ppt). Over 69 percent of the total number of samples analyzed had no detectable residues (minimum detection limit = 0.022 $\mu g/m^3$; 1.7 ppt for a 24-hour sample). Application monitoring was conducted in July 1994 before, during, and for 72 hours after an application to a walnut orchard in Glenn county. Azinphos-methyl was aerially applied at the rate of 2 pounds of active ingredient per acre. Positive detections at each field sampling site occurred only during one sampling interval (during and one hour after application, total sampling interval = 2.5 – 3.0 hours), and ranged from 0.69 $\mu g/m^3$ (0.05 ppb) to 1.7 $\mu g/m^3$ (0.13 ppb). Nearly 87 percent of the total number of samples analyzed had no detectable residues (minimum detection limit = 0.08 $\mu g/m^3$; 0.01 ppb for a 12-hour sample).

What are the expected human exposures (dosage) to airborne concentrations of azinphos-methyl, and when do these exposures occur

Kern County has the highest use of azinphos-methyl in California when compared to the other counties. Approximately 30% of the total yearly use is applied in Kern County. The application season starts in April, and ends in August or September. People residing close to agricultural areas treated with azinphos-methyl in this county may have the greatest potential for exposure.

An azinphos-methyl ambient air monitoring study was conducted in several rural and urban locations in Kern County during June and July 1987. The data collected in this study suggest that of all sites tested, the residents in the Pond and McFarland areas of Kern County have the greatest potential exposure to airborne azinphos-methyl during the application season. This study was used to estimate the exposure of children, adult males and adult females to azinphos-methyl in the ambient air. Since the level of exposure to airborne azinphos-methyl depends on the rate of inhalation and the rate of inhalation varies between human sub-groups, total daily (24-hour) inhalation rate for each subgroup was used to estimate exposure.

The estimate of a single day or acute exposure to a person is expressed as the absorbed daily dosage (ADD). The 95th percentile of the airborne azinphos-methyl concentrations at each location during the monitoring period is used to calculate a single day exposure. Seasonal exposure to a person is expressed as seasonal average daily dosage (SADD). The mean airborne azinphos-methyl concentration during the entire monitoring period at each location is used to calculate a SADD. A seasonal exposure period of 5 months in a year (see discussion of use report in Part A) was used to calculate annual exposure or annual average daily dosage (AADD). Children had the highest estimates of exposure to azinphos-methyl in the ambient air. The highest estimated daily, seasonal, and annual exposures of children to azinphos-methyl in the ambient air were 61, 11, and 5 ng/kg/day, respectively, for a six-year old child.

Air Resources Board (ARB) conducted an azinphos-methyl application site air monitoring in July, 1994. Air samples were collected near an application site during and immediately after an application to an orchard. This study was used to estimate human exposure to airborne azinphos-methyl at an application site. The estimates of acute exposure to application site airborne azinphos-methyl at 20 yards downwind from the application ranged from 60 ng/kg/day for an adult female to 120 ng/kg/day for a child. Seasonal or chronic exposure to application site is not expected since no more than six repeated applications of azinphos-methyl can be made to a crop during a year due to label restrictions.

What are the potential acute and seasonal health effects of azinphos-methyl?

The primary health effects observed in laboratory animals after acute exposure to azinphos-methyl are neurological due to the inhibition of the enzyme, cholinesterase (ChE), which is involved in the termination of impulses across nerve synapses. Inhibition of ChE in the nervous system results in cholinergic signs, such as increased ocular and nasal discharges, increased salivation, breathing difficulties, staggering gait, tremors, twitching, and/or convulsions. Inhibition of ChE in the blood also occurs with exposure to azinphos-methyl. The toxicological significance of ChE inhibition in the blood is uncertain since the ChE in plasma and red blood cells have no known physiological function. However, there is evidence which plasma ChE may be involved in the binding or metabolism of certain drugs. The lowest established no-observed-effect level (NOEL) for overt toxicity in an acute study in animals was 1.0 mg/kg based on reduced activity and reflexes and brain ChE inhibition in rats administered a single oral dose. The NOEL for blood ChE inhibition in rats was estimated to be 0.1 mg/kg. In a human study, the acute NOEL for blood ChE inhibition was established at 0.75 mg/kg. With subchronic exposure in laboratory animals, additional effects were seen, including reduced body weights and food consumption, impaired spermatogenesis, and decreased survival of offspring during lactation. However, ChE inhibition remained the most sensitive endpoint. The subchronic NOEL for blood and brain ChE inhibition in rats was estimated to be 0.1 mg/kg/day. The effects seen in animals after chronic exposure to azinphos-methyl were similar to those seen with subchronic exposure, except histological changes in the uterus and gall bladder were seen. The lowest NOEL with

chronic exposure to azinphos-methyl was 0.28 mg/kg/day based on blood and brain cholinesterase inhibition in rats

Is there any potential cancer risk from exposure to azinphos-methyl?

There was limited evidence that azinphos-methyl may be genotoxic and carcinogenic. In a rat carcinogenicity study, males had an increase in tumors of the pancreas, thyroid, and adrenal glands. An increase in the liver tumors was also seen in males in a mouse carcinogenicity study. However, both of these studies had an inadequate number of concurrent control animals that made interpretation of these findings difficult. Furthermore, there was no increase in these tumors in either species in well-conducted carcinogenicity studies. There was evidence that azinphos-methyl caused mutations and chromosomal abnormalities in several studies using tissue cultures, but there was no evidence of chromosomal abnormalities in any studies using live animals. DPR concluded that the limited evidence of carcinogenicity in animals for azinphos-methyl was insufficient to warrant further evaluation for cancer potential.

Does the concentration of azinphos-methyl in ambient air pose a potential health hazard for humans?

The risk for potential health effects from acute and chronic exposure is expressed as a margin of exposure (MOE). The MOE is the ratio of the NOEL from the human or animal studies to the estimated human acute, seasonal or chronic exposure dosage. The MOEs for acute effects from offsite and ambient air ranged from 800 to 17,000 depending on the NOEL selected and the population subgroup. The MOEs for seasonal and chronic effects were greater than 8,800 and 60,000, respectively. Generally, an MOE greater than 100 is desirable when the NOEL is derived from animal data to allow for interspecies and intraspecies differences in susceptibility. When the NOEL is derived from human data, an MOE of at least 10 is generally considered adequately protective. Reference concentrations (RfCs) were calculated for azinphos-methyl by dividing the acute, subchronic and chronic NOELs by an uncertainty factor of 10 or 100 to allow for interspecies and intraspecies differences in susceptibility. The acute RfCs for azinphos-methyl ranged from 1.3 $\mu g/m^3$ (0.10 ppb) to 101

µg/m^3 (7.8 ppb) depending on the NOEL used. The seasonal and chronic RfCs were 1.3 µg/m^3 (0.10 ppb) and 3.8 µg/m^3 (0.29 ppb), respectively, based on blood and brain ChE inhibition in rats.

Do any of the degradation products of azinphos-methyl pose a potential health hazard?

The active metabolite of azinphos-methyl was identified as the oxygen analog. The concentration of the oxygen analog needed to inhibit 50% of rat brain ChE was several orders of magnitude lower than of azinphos-methyl. No additional toxicity data was available for the oxygen analog. Only limited acute toxicity data was available for two degradation products of azinphos-methyl, benzazimide and methyl benzazimide. The median lethal dosage for both of these compounds was significantly higher than for azinphos-methyl. The clinical signs observed in animals with both compounds were sedative in nature.